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Prolonging the shelf life of wheat germ with Guar, Carboxymethyl cellulose and Persian gum by freeze-drying encapsulation method

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ABSTRACT

Wheat germ is the embryo of the wheat grain and is abundant in tocopherol, protein, and omega-3 fatty acids. Wheat germ has high enzyme activity, which reduces its shelf life. Wheat germs are often eliminated during the milling of wheat grains to extend the shelf life of the flour and avoid the formation of an unpleasant taste in the flour. The goal of this study was to enhance the storage life of wheat germ by freeze-drying encapsulation using guar, carboxymethyl cellulose, and Persian gums. The current study employed a 1:0.05 ratio for maltodextrin: different gums mixes, and physicochemical and microbiological tests were performed on the samples throughout a 360-day storage period. The collected data was evaluated using a completely random design. SPSS was used for statistical analysis of the samples, and averages were compared using Duncan's test at a significance level of 1%. The results showed that the amount of peroxide in CMC gum treatment decreased with time. Anisidine and totox levels were also reduced by Persian gum and maltodextrin. The amount of yeast in maltodextrin, Persian, CMC, and guar treatments decreased, whereas total bacterial count values increased in Persian gum, guar, maltodextrin, and CMC treatments. Investigating wheat germ encapsulation to extend product shelf life revealed that the efficacy of this technology is dependent on the kind of wall material as a primary parameter. The mixing of various gums and materials with other gums may be useful in increasing the physicochemical characteristics of the resulting microcapsules.

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1-Introduction

Cereal sprouts are the richest source of amino acids, vitamins and minerals and also contain adequate amounts of fiber. They contain a wide range of vitaminsI see (A, B, C, D, E, K and folic acid) and are excellent sources of iron, potassium, calcium, phosphorus, magnesium and zinc.[1] The wheat germ is the most nutritious part of the wheat kernel. This product has 381 calories per 100 grams, 54% of which are provided by carbohydrates, 23% by proteins and 23% by lipids. It also contains significant amounts of thiamin, riboflavin, niacin, phytosterols and policosanols [2]. In addition, it is a rich source of antioxidants.[3] Wheat germ is effective in preventing cancer, diabetes, high blood pressure and Alzheimer's disease. The acceptable percentage of unsaturated fatty acids in wheat germ oil plays an important role in reducing blood cholesterol and treating arteriosclerosis and heart diseases [4]. The widespread use of sprouts is limited due to the rapid sourness of this material after separation from the core [5]. The presence of unsaturated fats as well as hydrolytic and oxidative enzymes causes rapid destruction of wheat germ. Enzymes, lipoxygenase and lipase, degrade lipid molecules and cause acidity and volatile compounds [6]. which is the main limitation for industrial applications of wheat germ [7]. It is practically impossible to remove the intact germ in the conventional milling process before milling the kernel, especially in the case of soft wheat. Wheat germs are generally removed during milling of wheat grains to increase the shelf life of the flour and prevent strong flavors from rancid oils in the flour. Therefore, the presence of wheat germ in flour has a negative effect on its stability [8]. The purpose of this research is to investigate the physicochemical and oxidation indicators in wheat germ coated by freeze drying method with combined maltodextrin-persian gum, maltodextrin-guar gum, maltodextrin-carboxymethyl cellulose gum, maltodextrin alone and sprout without gum coating as The witness was in the period of one year.

2- Materials and methods

raw materials in the production of wheat germ capsules, including wheat germ from Kalil Javane company, maltodextrin, carboxymethyl cellulose and guar from Sigma American company and Farsi gum fromRihan Gam Parsianwere purchased

Method of preparation of embedded treatments

wheat germ in each treatment in the following orderUndercover became: 1. TuzYn material dYturn (maltodextrin gum, guar, Farsi and carboxymethyl cellulose) in the proportions mentioned in table (1), 2. Solving material dYturn in the water Distilling and mixing them completely using an electric stirrer, 3. Weighing the wheat germ and mixing it with the wall material. 4. Divide into glass plates, 5. Place in freezer at -40 degrees Celsius for 24 hours, 6. Transfer plates from freezer to freeze dryer.For the control sample, the wheat germ sample without any coating with maltodextrin-gum combination and the wheat germ sample coated with only maltodextrin on the first day, one hundred and eighty three hundred and sixty, together with the samples coated with gum combination.Maltodextrin - Persian gum, maltodextrin - guar gum, maltodextrin - carboxymethyl cellulose gum) was examined and tested. Tests of peroxide, anisidine, totox, acidity, thiobarbituric acid, mold and yeast count and total count of microorganisms were performed in rounds during 360 days of storage on days 0, 180 and 360.

Table 1. Treatments and mixing ratio of the gums used for the walls of the capsules

Treatments	Maltodextrin	Persian gum	Guar gum	CMC
Wheat germ & maltodextrin-Persian gum	1	0.05	-	-
Wheat germ & maltodextrin-Guar gum	1	-	0.05	-

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Wheat germ & maltodextrin-CMC	1	-	-	0.05
Wheat germ & maltodextrin(control 1)	1	-	-	-
Wheat germ(control 2)	-	-	-	-

Enumeration of microorganisms

Determining the amount of mold and yeast and counting the total number of microbes by the methodIranian National Standard No. 10899-3) was done [9].

Tests performed on extracted oil

In order to extract oil, the produced samples were powdered using an electric mill. Each sample was weighed to a certain amount and 600 cc of petroleum ether was added to it. The lid of the besars was covered with aluminum foil. After 24 hours, the extracted oil from the sample was passed through a strainer, and the filtered mixed petroleum ether was separated from the oil using a rotary evaporator under vacuum, and the oil was obtained for testing.

Peroxide number

The peroxide value was obtained by iodometric method. For this purpose, 2 grams of extracted oil along with 30 milliliters of acetic acid-chloroform (1:1) and 0.5 milliliters of saturated potassium iodide were poured into an Erlenmeyer flask and placed in the dark for 2 minutes. Then 30 ml of distilled water and 0.5 ml of starch glue were added. The resulting mixture was titrated using 0.1 normal sodium thiosulfate until it became colorless, and the amount of thiosulfate consumed was recorded. For example, all steps were performed without primary oil [10]. In this relation, S is the amount of sodium thiosulfate used for oil sample titration, B is the amount of sodium thiosulfate used for control titration, N is the normality of sodium sulfate, and W is the oil weight in grams.

Peroxide number (milliequivalents of oxygen per kilogram of oil)= $\frac{(S-B)\times N\times 1000}{IN}$

Anisidine number

3 The gram of the extracted oil was weighed in a flask and the volume was 25 cc with hexane, and its absorbance was read at a wavelength of 350 nm.A_b). 5 cc of the solutionA_b was removed and 1 cc of anisidine reagent (0.25 grams of para-anisidine which has been adjusted to 100 with acetic acid) was added to it. After 10 minutes in the dark, the absorbance was read at 350 nm (A_s)[11]. A_S The amount of fat absorption after reaction with anisidine,A_bAbsorption of fat solutionINsample weight,IN volumetricin which the sample was solved in terms of sis and 1.2 correction factor for rQSolution collaring The sample is anisidine reagent with one cc.

Anisidine = $\frac{in\times(1.2\times A_S-A_b)}{In}$

Totox number

The calculation of Totox number was obtained from the sum of twice the number of peroxide plus the number of anisidine.[10]

Total acid number

20 grams of sample oil along with 30 1 cc of ethanol and 1 cc of 0.01 phenolphthalein was poured into Erlenmeyer flask and the titration was carried out using 0.1 normal sodium until a purple color was reached. [12].

Total acid value (mg of oleic acid per kg of oil) = $\frac{2.82\ x\ normal\ consumption\ of\ 0.1\ milliliters}{Sample\ weight}$

Thiobarbituric acid number

0.2 g of the extracted oil was poured into a 25 ml flask and made up to volume with butanol. 5 ml of it was removed and transferred to a dry laboratory tube. Then 5

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ml of solution Thiobarbituric acid was added to it and the laboratory tube was kept in a 95°C water bath. After 2 hours, the tube was removed from the bath and cooled. Finally, its absorbance was read at 530 nm. All steps were also performed for the control sample [13].

$$\frac{(Absorption\ sample - absorption\ sample\ control) \times 50}{Sample\ weight}$$

= number of thiobarbituric acid (mg of malondialdehyde per kg of oil)

Statistical Analysis

The data obtained from this research were analyzed in the form of a completely random design. Statistical analysis of the samples was done by SPSS version 16.Averages using Duncan's test at confidence level 95% were compared andCharts using Excel software was drawn

3- Results and Discussion

Examining the effect of gum treatmentCarboxymethyl celluloseGuar gum, Persian gum, wheat germ, maltodextrin and storage time on free acidity, peroxide indicators,Thiobarbituric acid, anisidine and totox in encapsulated wheat germ

According to the analysis of variance in Table 2, the independent effect of treatment and the interaction effect of treatment-time on the changes in total acidity number (mg/kg) are significant (<0.01). P) have been. Figure 1 shows the interaction effect of treatment-time on changes in total acidity number (mg/kg). According to the graph, the highest and lowest values are respectively related to gum treatmentCarboxymethyl celluloseAt the time of 180 DayAnd guar gum treatments are 360 days and maltodextrin 180 days. Amounts of gumCarboxymethyl celluloseIt has increased significantly in 180 days compared to 0 and 360 days. The amount of guar gum has decreased significantly in 360 days compared to zero and 180 days.

Table 2. Analysis of variance of changes in total acidity number (mg of linoleic acid/kg of oil extracted from wheat germ)

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	10696.800	14	764.057	2.882	.007
Intercept	741895.200	1	741895.200	2798.197	.000
Treatment-type	3158.356	4	789.589	2.978	.035
Storage-time	1701.733	2	850.867	3.209	.055
Treatment type-storage time	5836.711	8	729.589	2.752	.021
Error	7954.000	30	265.133		

R Squared = 0.854 (Adjusted R Squared = 0.835)

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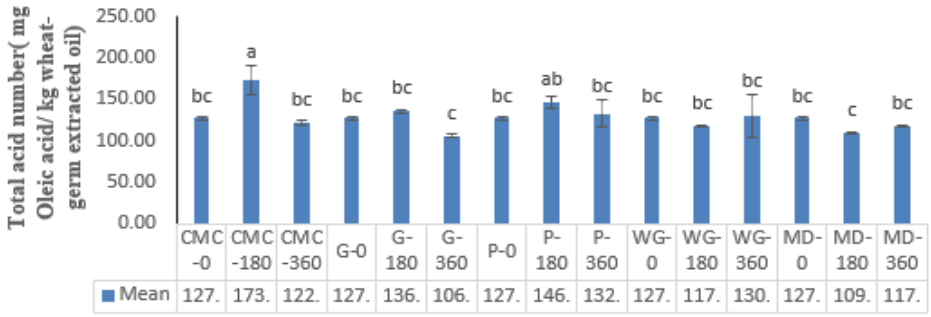

Fig. 1. Treatment type-storage time interaction effect on the total acidity number in wheat germ oil. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

According to the analysis of variance in Table 3, the independent effect of treatment, storage time and the interaction effect of treatment-time on changes in peroxide number (mE/kg) are significant (<0.01).P) have been. Diagram 2 shows the effect of treatment on peroxide values. According to the graph of guar gum treatment, it has the highest gum treatmentCarboxymethyl celluloseIt has the lowest amount of peroxide. Also, its values do not show a significant difference in Persian gum, wheat germ and maltodextrin treatments. Figure 2 shows the interaction effect of treatment-time on peroxide number values. The values of this index in the treatments of guar gum, time of 180 days and gum, respectivelycarboxymethyl cellulose,The time of 360 days is significantly higher and lower than other treatments. Treatment values of Persian gum and gumCarboxymethyl celluloseIt has decreased significantly in 360 days compared to zero day. The values of this index in guar gum and maltodextrin increased significantly in 180 days compared to 0 and 360 days.

Table 3. Analysis of Variance of peroxide value (meq of oxygen/kg of oil extracted from wheat germ)

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	4.557	14	.326	3.975	.001
Intercept	57.483	1	57.483	701.927	.000
Treatment-type	1.259	4	.315	3.844	.012
Storage-time	1.442	2	.721	8.805	.001
Treatment type-storage time	1.856	8	.232	2.833	.018
Error	2.457	30	.082		

R Squared = 0.850 (Adjusted R Squared = 0.786)

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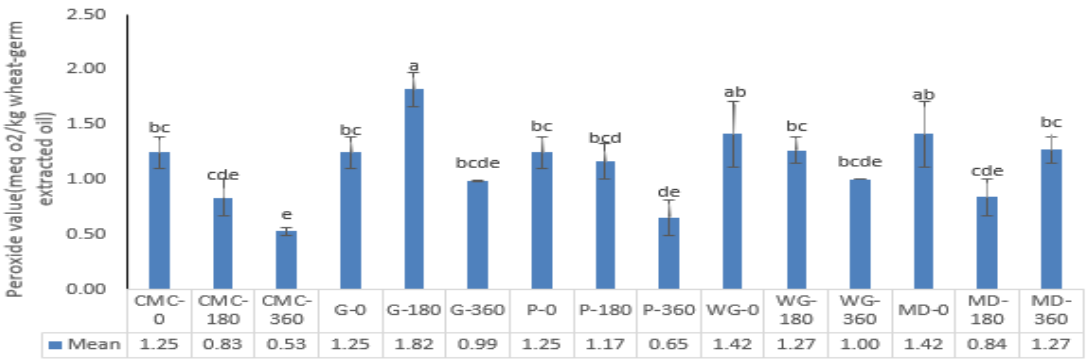

Fig. 2. Treatment type-storage time interaction effect on the peroxide value in wheat germ oil. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

According to analysis of variance in Table 4, the independent effect of storage time and the interaction effect of treatment-time on anisidine changes are significant (<0.01). P) have been. Figure 3 shows the interaction effect of treatment-time on the anisidine index. Guar gum and gumCarboxymethyl celluloseAt the time of 360 days, Persian gum and maltodextrin at the time of 180 days have the highest and lowest amounts of anisidine, respectively. Amounts of guar gum andCarboxymethyl celluloseIt has increased significantly in 360 days compared to zero and 180 days. As for Persian gum, its values are significantly higher at 360 days compared to zero and 180 days. Also, its values have decreased significantly in 180 days compared to zero and 360 days. The values of this index in the wheat sprout treatment at 360 days are significantly higher compared to zero and 180 days. Also, its values on day 0 have decreased significantly compared to 180 and 360 days. The values of this index in the treatment of maltodextrin in 180 days compared to zero and 360 days have significantly decreased.

Table 4. Analysis of variance of anisidine value

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	12.677	14	.906	46.575	.000
Intercept	172.990	1	172.990	8897.626	.000
Treatment - type	1.482	4	.370	19.056	.000
Storage-time	8.742	2	4.371	224.810	.000
Treatment type-storage time	2.454	8	.307	15.776	.000
Error	.583	30	.019		

R Squared = 0.956 (Adjusted R Squared =0.935)

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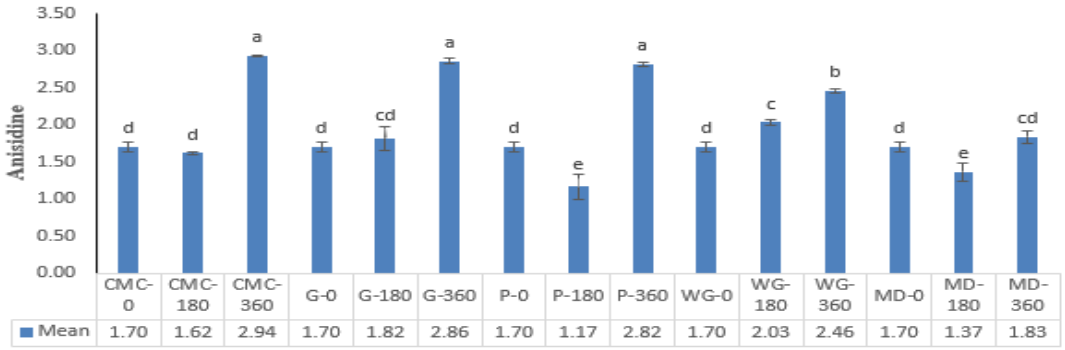

Fig. 3. Treatment type-storage time interaction effect on the anisidine value in wheat germ oil. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

According to the analysis of variance in Table 5, the independent effect of treatment, storage time and the interaction effect of treatment-time on the indexThiobarbituric acid (mg/kg) significant (<0.01). P) have been. According to chart 4, the highest values of this index in gum treatmentCarboxymethyl celluloseAnd the time of 360 days and the lowest time is observed in maltodextrin treatment and time of 180 days. The values of this index in gum treatmentcarboxymethyl cellulose,Farsi and wheat sprouts have significantly decreased at zero time compared to 180 and 360 days. Also, the values of the above index in maltodextrin treatment for 360 days have been significantly reduced compared to other treatments at the same time.

Table 5. Analysis of variance of thiobarbituric acid value (mg of malondialdehyde/kg of oil extracted from wheat germ)

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	174.745	14	12.482	45.344	.000
Intercept	11906.224	1	11906.224	43253.068	.000
Treatment-type	27.704	4	6.926	25.160	.000
Storage-time	115.192	2	57.596	209.236	.000
Treatment type-storage time	31.849	8	3.981	14.463	.000
Error	8.258	30	.275		

R Squared = 0.955 (Adjusted R Squared = 0.934)

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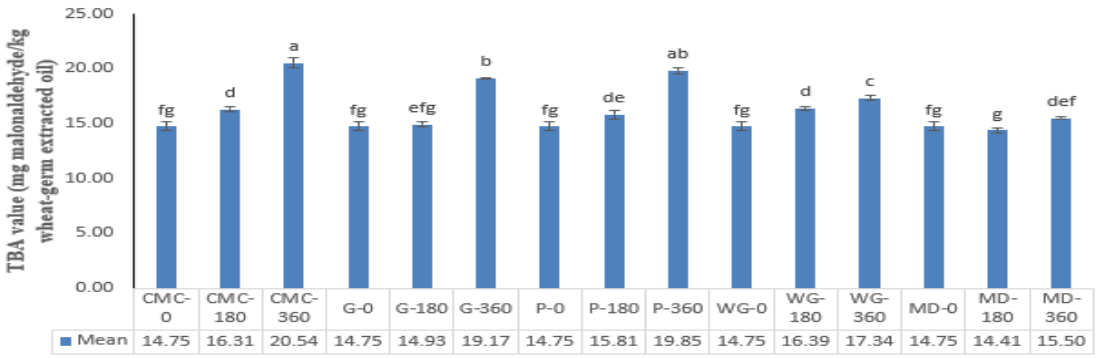

Fig. 4. Treatment type-storage time interaction effect on the thiobarbituric acid value in wheat germ oil. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

According to the analysis of variance in Table 6, the independent effect of treatment and the interaction effect of treatment-time on Totox index are significant (<0.01). P) have been. Figure 5 shows the mutual effect of storage time and type of treatment on this index. According to the graph of the values of this index in guar gum treatment and gum treatment Carboxymethyl cellulose Compared to other treatments, it is significantly higher and lower.

Table 6. Analysis of variance of totox value (meq of oxygen/kg of oil extracted from wheat germ)

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	9.707	14	.693	2.911	.007
Intercept	769.213	1	769.213	3229.637	.000
Treatment-type	4.490	4	1.123	4.713	.005
Storage-time	1.597	2	.799	3.354	.048
Treatment type-storage time	3.619	8	.452	1.900	.097
Error	7.145	30	.238		

R Squared = 0.876 (Adjusted R Squared = 0.778)

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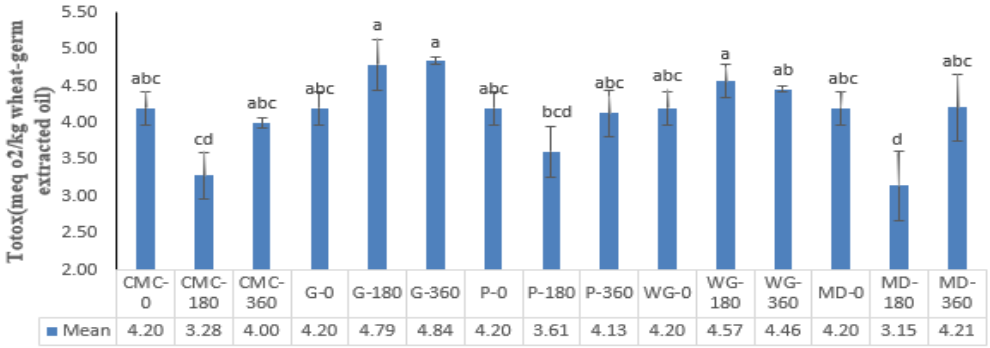

Fig. 5. Treatment type-storage time interaction effect on the changes of the totox value in wheat germ oil. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

Unstable hydroperoxides produced in the initial stages of lipid oxidation are subsequently decomposed into secondary oxidation products, i.e. ketones, aldehydes, and alcohols, and these volatile products cause off-flavors in food products.[14]. Therefore, the oxidation of lipids leads to important changes in the sensory characteristics of products, including taste, smell, texture, and color, which are easily recognized by the consumer, and as a result, this reaction significantly limits the shelf life of the product [15]. In general, the independent effect of storage time in 360 days causes the increase of index indices Thiobarbituric acidand anisidine and peroxide reduction. Generally ,gum Carboxymethyl cellulose , significantly reduced the amounts of totox and peroxide. The highest amounts of peroxide and totox are also observed in guar gum. The highest amounts of anisidine in gum treatments Carboxymethyl cellulose, guar and Farsi in 360 days and its lowest values are observed in Persian gum and maltodextrin treatment in 180 days. Instantaneous values ZIodine significantly decreases in Persian gum and maltodextrin treatment in 180 days compared to zero day and 360 days. gum treatment Carboxymethyl cellulosein 360 days and maltodextrin in 180 days have the highest and lowest index values, respectively. Thiobarbituric acid Are. Regarding the Totox index, guar gum treatment at 180 and 360 days and wheat germ at 180 days showed the highest and maltodextrin at 180 days, respectively, showed the highest and lowest values. Effect of silver-gum nanoparticle coating Carboxymethyl cellulose and silver-guar, were studied in quinoa fruit on its stability during storage[16]. A significant relationship between storage temperature and antioxidant activity was observed. Antioxidant activity of quinoa fruits treated with silver-gum nanoparticles Carboxymethyl cellulose and silver-guar increased significantly at 4°C during storage. On the contrary, the antioxidant activity of the control samples kept at temperatures of 4 and 10 degrees Celsius decreased continuously. The results of antioxidant activity also showed that silver nanoparticle coatings stimulate oxygen storage capacity in quinoa fruit during storage at low temperature. It has been reported that the antioxidant activity depends on ascorbic acid, total phenol, anthocyanins and flavonoids. The highest amount of total acid value in gum treatment Carboxymethyl cellulose , in 180 days and its lowest value was observed in guar treatment and 360 days. Also between Persian gum treatment and gum treatment Carboxymethyl cellulose , in 180 days and guar treatment in 360 days and maltodextrin treatment in 180 days, no significant difference is observed in terms of total acid number index. In general, guar gum caused a significant decrease in the total acid number. Also, in Persian gum, maltodextrin and wheat germ, no significant difference was observed with guar gum in terms of total acid index values.

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Peroxide index in guar gum treatments in 180 days and gumCarboxymethyl cellulose In 360 days, it has the highest and lowest values, respectively. Amounts of peroxide in gum treatmentsCarboxymethyl cellulose and Farsi, in the time of 360 days, compared to the zero day, it decreases significantly. The amount of peroxide in guar gum treatment increases significantly in 180 days compared to day 0 and day 360. Also, the amount of peroxide in maltodextrin treatment is significantly reduced in 180 days compared to zero day. Since the wheat germ is subjected to physical pressure in the process of grinding wheat by pressing rollers, its contact surface is increased and the inherent gum coating of the germ is not enough and the result is the oxidation of most of the compounds prone to oxidation. Therefore, in this research, coating with gum external and non-intrinsic, we tried to prevent the oxidation of active compounds prone to oxidation, therefore, the type of coating process and of course the type of wall compounds are very effective in preserving and preventing the oxidation of active compounds during storage, so that our results are in agreement with the research of Ballesteros et al. (2017) is aligned. They stated that two factors, the type of encapsulation process (spray drying or freeze drying) and the wall material (gum arabic, maltodextrin or a combination of both) were the most effective factors for encapsulation of antioxidant phenolics extracted from coffee beans. Although gum arabic showed higher thermal stability, maltodextrin was reported to be the best wall material for retaining phenolic compounds and flavonoids inside the capsules, especially by using freeze-drying method, with encapsulation efficiency of 62% and 73%. It has the highest antioxidant activity (86% of the original extract) compared to other samples [17].

Examining the effect of gum treatmentCarboxymethyl cellulose, guar gum, Persian gum, wheat germ, maltodextrin on the total count and yeast of encapsulated wheat germs in 360 days.

According to chart 6, total count values in 360 days in guar and Persian gum treatments compared to gum.Carboxymethyl celluloseAnd maltodextrin has been significantly reduced. If between the values of this index in gum treatmentCarboxymethyl celluloseand maltodextrin, no significant difference is observed. According to chart 7, the amounts of yeast in maltodextrin treatment, Persian gum, gumCarboxymethyl celluloseAnd guar gum has decreased significantly in 360 days, respectively. In such a way that the highest values are observed in maltodextrin gum and the lowest values are observed in guar gum.

Examining the effect of gum treatmentCarboxymethyl cellulose, guar gum, Persian gum, wheat germ, maltodextrin on the total count and yeast of encapsulated wheat germs in 360 days.

According to chart 6, total count values in 360 days in guar and Persian gum treatments compared to gum. Carboxymethyl celluloseAnd maltodextrin has been significantly reduced. If between the values of this index in gum treatment Carboxymethyl celluloseand maltodextrin, no significant difference is observed. According to chart 7, the amounts of yeast in maltodextrin treatment, Persian gum, gum Carboxymethyl celluloseAnd guar gum has decreased significantly in 360 days, respectively. In such a way that the highest values are observed in maltodextrin gum and the lowest values are observed in guar gum.

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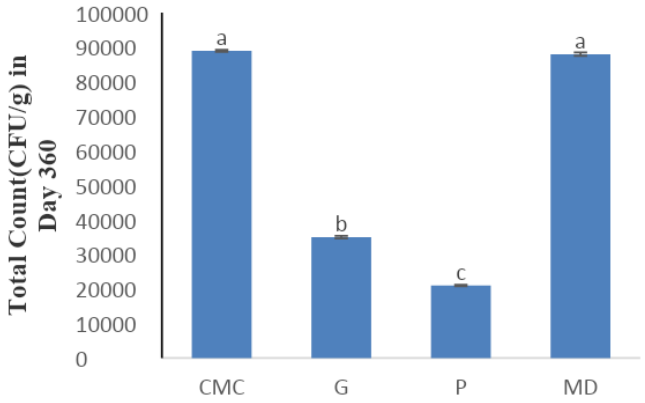

Fig. 6. Treatment type simple effect on the total count in wheat germ on the 360th day after encapsulation. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

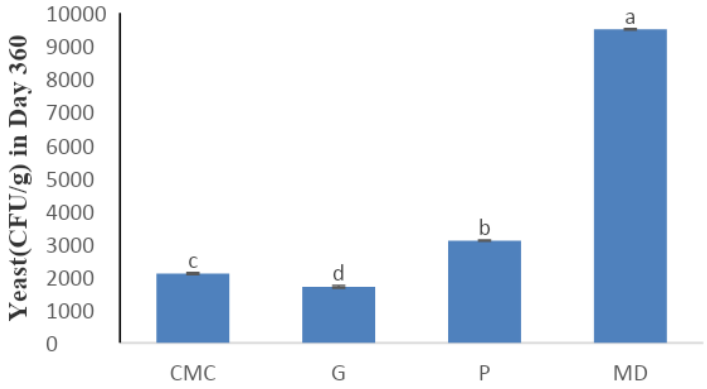

Fig. 7. Treatment type simple effect on the yeast count in wheat germ on the 360th day after encapsulation. Means ± SE (n = 3) with different letters on each column indicate significant difference ($p < 0.05$).). CMC: Carboxy methyl cellulose, G: Guar gum, P: Persian gum, WG: Wheat germ, MD: Maltodextrin.

Amounts of yeast in maltodextrin treatments, Farsi,Carboxymethyl cellulose Veguar, the decreasing trend and total bacterial count values in the treatments of Persian gum, guar, maltodextrin andCarboxymethyl celluloseIt shows an increasing trend. Antimicrobial properties of Persian gums andCarboxymethyl cellulosestudied [18]. The results showed that the use of Persian gum treatment and gumcarboxymethyl cellulose,During 12 days of storage at 4 degrees Celsius, it significantly increased the amount of studied bacteria. Dried microcapsules of peppermint oil were produced using gum arabic alone and its combination with depolymerized guar gum enzymatically by spray drying method.[19, 20]. The microcapsules were evaluated for the retention of peppermint oil during 8-week storage. Microcapsules produced with radiation depolymerized guar gum as wall material were better able to retain the main compounds of peppermint oil such as menthol and isomenthol. The results showed that a combination of guar gum and gum arabic is better than gum arabic alone as a wall material to preserve the taste. The effect of using maltodextrin as a growth inhibitor against*Candida albicans* studied The results showed that the use of maltodextrin increased the values*Candida albicans* can be As a result, its effect on inhibiting fungal growth is negative[21].

4 - Conclusion

According to the obtained results, the treatment gumcarboxymethyl cellulose,During the days of storage, it causes a decrease in the process of increasing

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peroxide. Also, guar gum and maltodextrin decrease the total acid value. Also, Persian gum and maltodextrin treatments have a decreasing effect on anisidine and totox levels. The use of maltodextrin increases the amount of fungi and the total microbial count. Also gumCarboxymethyl cellulose, also does not have an antimicrobial effect.

5- Gratitude

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6- Conflict of benefits

The authors have no conflicts of interest to declare.

7- Resources

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مقاله علمی_پژوهشی

افزایش عمر نگهداری جوانه گندم به کمک صمغ‌های گوار، کربوکسی متیل سلولز و فارسی به روش درون‌پوشانی از نوع خشک کن انجمادی

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چکیده

جوانه گندم، جنین دانه گندم است و حاوی مقدار زیادی توکوفرول، پروتئین و اسیدهای چرب با کیفیت بالا می‌باشد. جوانه گندم دارای فعالیت آنزیمی قابل توجهی است که ماندگاری آن را محدود می‌کند. جوانه‌های گندم به طور کلی در طول آسیاب دانه‌های گندم حذف می‌شوند تا ماندگاری آرد افزایش یابد و از ایجاد طعم نامطلوب در آرد جلوگیری شود. هدف از این مطالعه، افزایش عمر نگهداری جوانه گندم به کمک صمغ‌های گوار، کربوکسی متیل سلولز و فارسی به روش درون‌پوشانی از نوع خشک‌کن انجمادی بود. در پژوهش حاضر، از نسبت ۱ : ۰/۰۵ برای مخلوط‌های مالتودکسترین: صمغها استفاده شد و آزمون‌های فیزیکوشیمیایی و میکروبی روی نمونه‌ها در دوره نگهداری ۳٦۰ روزه انجام شد. داده‌های بدست آمده، در قالب طرح کاملا تصادفی تجزیه و تحلیل گردید. میانگین‌ها با آزمون دانکن در سطح معنی داری یک درصد مقایسه شدند. نتایج حاکی از کاهش مقادیر پراکسید در طی روزهای نگهداری در تیمار صمغ کربوکسی متیل سلولز بود. صمغ فارسی و مالتودکسترین نیز دارای اثر کاهشی بر مقادیر آنیزیدین و توتوکس بودند. مقادیر مخمر در تیمارهای مالتودکسترین، فارسی، کربوکسی متیل سلولز و گوار روند کاهشی و مقادیر شمارش کلی باکتری در تیمارهای صمغ فارسی، گوار، مالتودکسترین و کربوکسی متیل سلولز روندی افزایشی را نشان داد. بررسی درون‌پوشانی جوانه گندم جهت افزایش ماندگاری این محصول نشان داد که کارایی این تکنیک به نوع مواد دیواره به عنوان یک پارامتر اصلی بستگی دارد و استفاده از صمغ‌ها و مواد مختلف در ترکیب با سایر صمغ‌ها شاید بتواند در بهبود ویژگی‌های فیزیکوشیمیایی کپسول‌های تولید شده موثر باشد.

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